Space Weather Technical Forecast

Issued on Tuesday 19 November 2024 at 12:53 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

---

Space Weather Forecast Headline: High Speed Stream solar winds bring a likelihood of enhanced geomagnetic activity from Day 3 (21 Nov).

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Over the last 24 hours, solar activity has been Moderate. However, much of this activity took place during the afternoon of the 18 Nov, peaking at M3.7 at 18/1253 UTC from AR3901 near the southeast limb, with flare activity easing to see generally background C-class flares during the morning of the 19 Nov.

There are currently eight sunspot regions on the visible disc. The largest region, AR3889 is continuing to rotate around the western limb, but given its magnetic complexity does still pose a risk of flares. AR3901 in the southeast is showing some magnetic complexity, although it remains difficult to analyse due to foreshortening, but some complex magnetic looping appears present in imagery. AR3898 near the centre disc in the southern hemisphere, appears to be developing quickly as it rotates west. The other regions are simple and magnetically uncomplicated.

At 18/1112UTC an M1.6 flare originating from AR3897 in the southwest produced a CME, which was slow-moving. This has been analysed using LASCO C2 and C3 imagery. Results show that this feature is a clear miss, passing ahead of Earth' orbit. A large CME was observed off the east limb, associated with an M2 flare near AR3901 in the southeast at 18/1913 UTC. From analysis this looks like a clear miss to Earth. No Earth-directed CMEs were observed over the past 24 hours in available imagery.

Solar Wind / Geomagnetic Activity: Solar winds at L1 reached between 400-480km/s, peaking at 18/1441 UTC, before slowly declining, currently near 360km/s at present. The solar wind density was below average. The interplanetary magnetic field (IMF), Bt, was weak to moderate 5-9nT. The north-south component was weakly negative, reaching -5nT at 18/2200 UTC, with brief weakly positive intervals overnight, before returning to weakly negative this morning. The phi angle was mostly positive (away from the Sun) overnight before becoming variable this morning. Geomagnetic activity was Quiet (0-2Kp) geomagnetic activity.

Energetic Particles / Solar Radiation: High energy proton flux observed by GOES18 remained at Background levels.

High energy electron flux (greater than 2MeV) observed by GOES16 was at Background to Moderate levels, with a diurnal peak of 529pfu observed at 18/1705 UTC. The associated 24-hour

© Crown Copyright 2024. All Rights Reserved.

fluence remained below the Active threshold, and the 24-hour integrated flux observed at 19/0000 UTC was 1.56e7.

Four-Day Space Weather Forecast Summary

Solar Activity: Low to Moderate activity is expected, with the arriving regions contributing to a daily chance of M-class flares and a persistent slight chance of isolated X-class flares.

Solar Wind / Geomagnetic Activity: No Earth-directed CMEs currently feature in the forecast.

Slow-Ambient winds around 350-400km/s are expected during Day 1 (19 Nov) and Day 2 (20 Nov) with an increasing risk of enhancement from CH93-/CH94- which is now approaching the centre disc. As a result, winds are expected to increase to Slightly elevated with speeds 450-500km/s arriving towards the end of Day 3 (21 Nov) and into Day 4 (22 Nov).

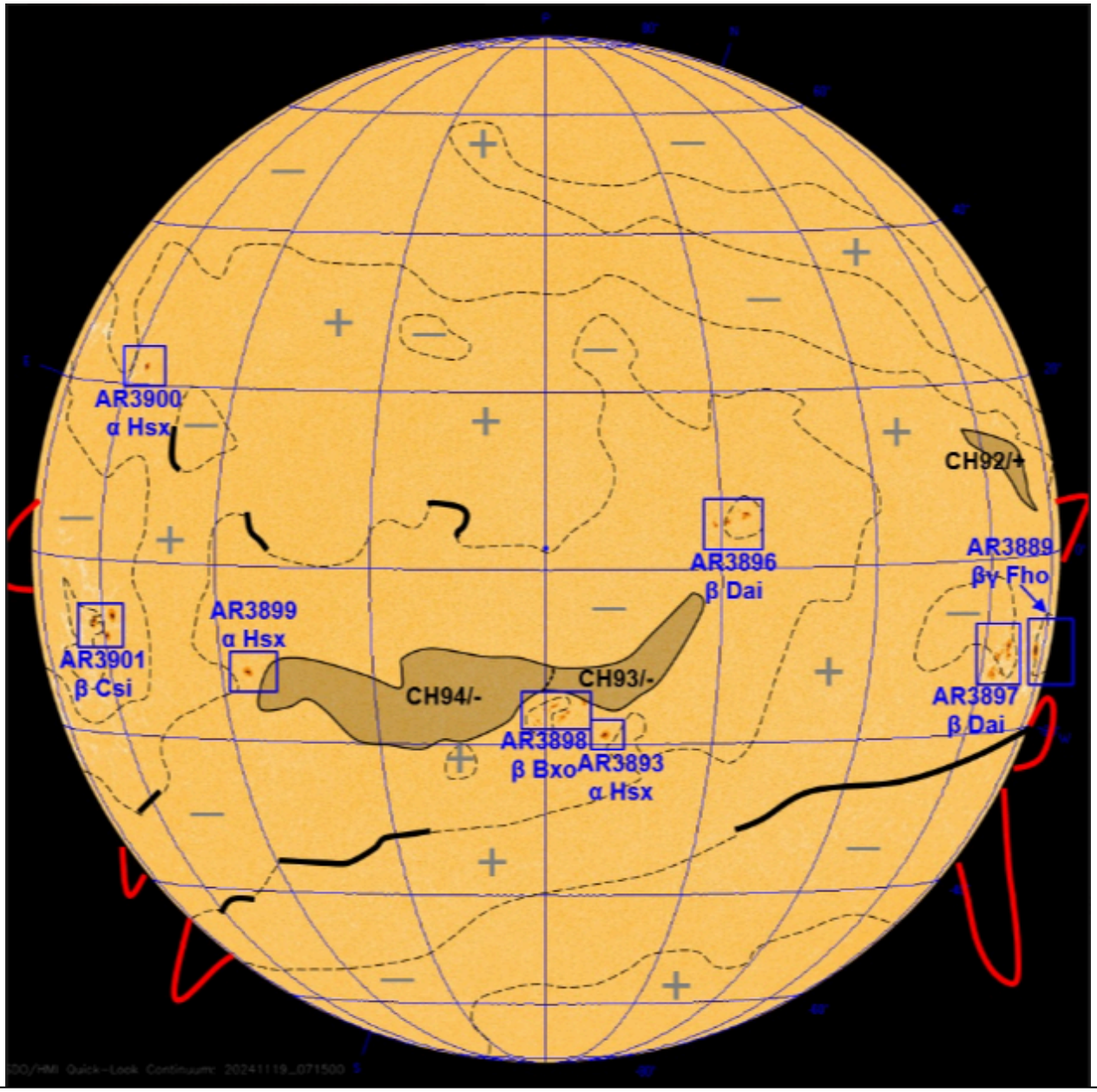
Quiet to Unsettled (Kp0-3) conditions expected through much of the period. Activity probably increasing through Days 3 and 4 (21-22 Nov) becoming generally Unsettled to Active (Kp3-4) with a chance of G1 Minor Geomagnetic Storm intervals.

Energetic Particles / Solar Radiation: There is a slight chance of S1/Minor solar radiation storms mainly due to AR3889's position as it crosses the western limb. High energy electron flux is likely to remain at background to moderate (during diurnal peaks) throughout the period. The associated fluence is expected to remaining below the Active (1e8 integrated flux) threshold.

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 370 900 0100 Email: enquiries@metoffice.gov.uk

© Crown Copyright 2024. All Rights Reserved.

Figure 1: Solar Synoptic Map valid 19/0800 UTC



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 370 900 0100 Email: enquiries@metoffice.gov.uk

© Crown Copyright 2024. All Rights Reserved.

Geomagnetic Storms

There are currently no Earth-directed CME's in the forecast, although this can change and short notice. Especially if we see any significant filaments lifting from the Sun.

The main driver for an Geomagnetic activity through the coming period will be a connection to High Speed Streams originating from CH93-, shortly followed by CH94-. Slow-Ambient winds around 350-400km/s are expected during Day 1 (19 Nov) and Day 2 (20 Nov) with an increasing risk of enhancement from CH93-/CH94- which is now approaching the centre disc. Winds are expected to increase to Slightly elevated as a result, with speeds 450-500km/s arriving towards the end of Day 3 (21 Nov) and into Day 4 (22 Nov). An enhancement in solar winds to 550-600km/s is currently suggested by MOSWOC Enlil output overnight on Day 1 (19 Nov), peaking during Day 2 (20 Nov), although this viewed with caution, probably considered too high and too early to bring in any enhancement.

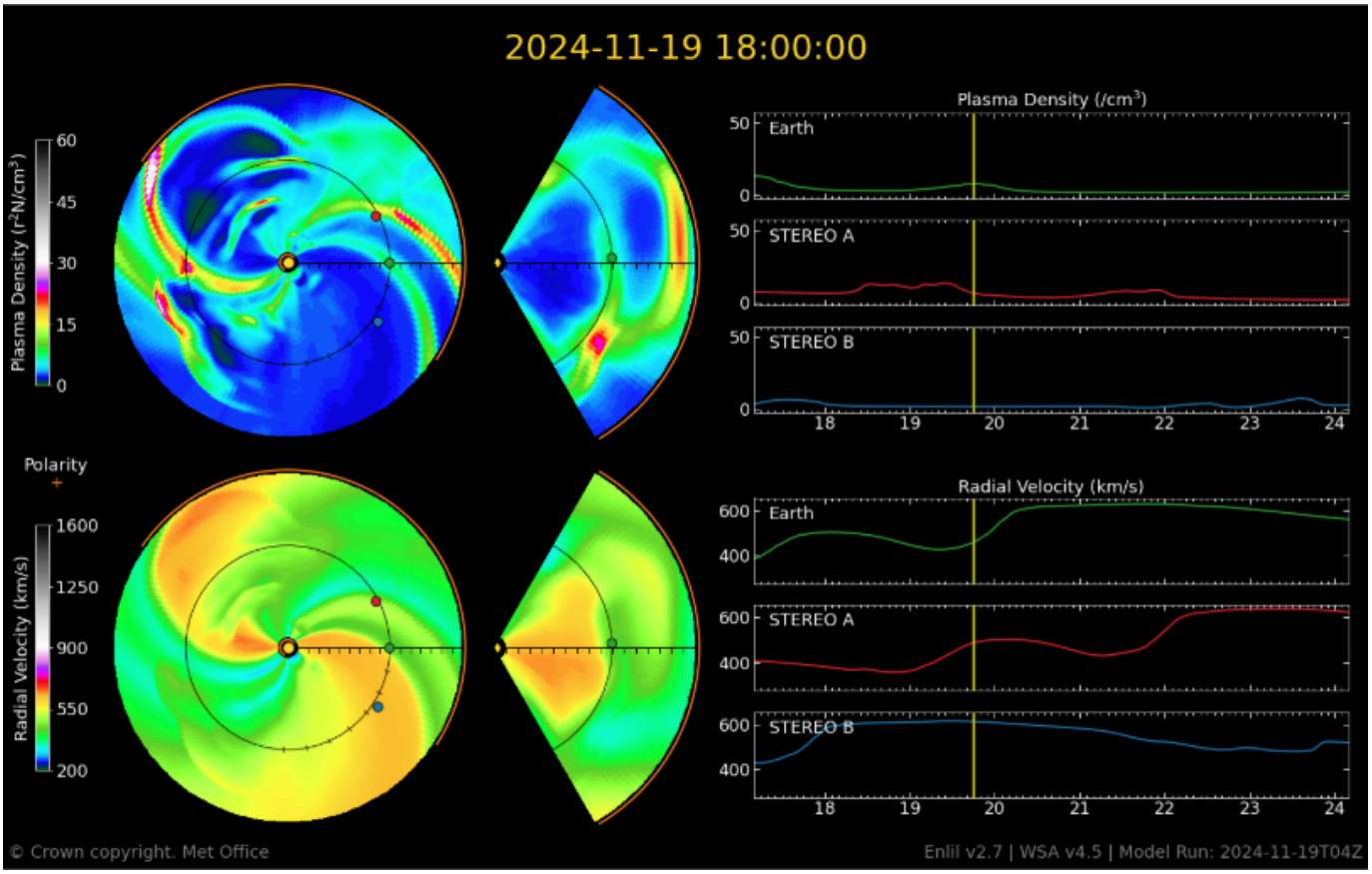
Quiet to Unsettled (Kp0-3) conditions expected through much of the period. Activity probably increasing through Days 3 and 4 (21-22 Nov) becoming generally Unsettled to Active (Kp3-4) with a chance of G1 Minor Geomagnetic Storm intervals depending on the strength of any enhancement from CH93- and CH94- and any associated CIR region.

Geomagnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	1	20	20
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 370 900 0100 Email: enquiries@metoffice.gov.uk

© Crown Copyright 2024. All Rights Reserved.

Figure 2: Latest Enlil output, showing a mark increase in solar winds this evening (19 Nov)



© Crown Copyright 2024. All Rights Reserved.

Radio Blackouts - X-Ray Flares

Currently, on the front side of the sun, there are eight sunspot regions. The largest, AR3889 in the southwest is continuing to rotate around the western limb, but given its history of producing M-Class flares and its continued magnetic complexity is still believe to be a risk for Moderate flares for the next 24 hours.

Recurrence, supported by brightening and magnetic looping on the eastern limb in SDO/AIA imagery and recent far-sided CMEs, continue to suggest the potential for sunspot regions to return to the visible disc over the period. Likely the first of which has emerged across the east limb, which has been numbered AR3901. AR3901 in the southeast of the disc brought several M-Class flares through yesterday, peaking at M3.7 around 18/1253 UTC. This region remains difficult to analyse due to foreshortening but some complex magnetic looping appears present in imagery.

AR3898 near the centre disc in the southern hemisphere, appears to be developing quickly as it rotates west.

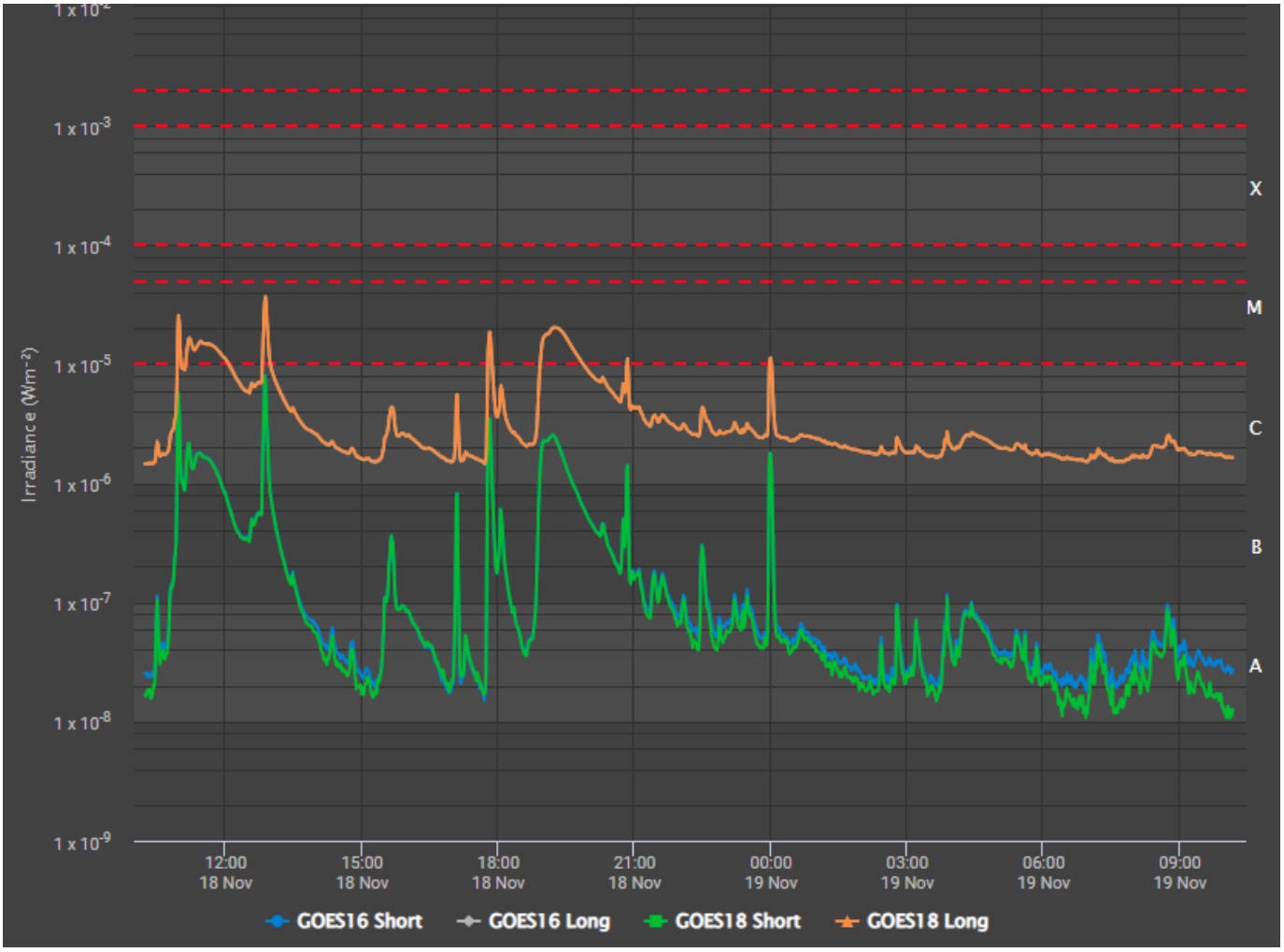
Overall Low to Moderate activity is expected, with the arriving regions on the east limb contributing to a daily chance of M-class flares and a persistent slight chance of isolated X-class flares, with the risk maintained steady through the period pending further developments. A chance of further Moderate activity and a continued slight chance of X-flares is maintained.

X-Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 (M Class)	Yes	50	50	50	50
Very Active	R3-R5 (X Class)	No	5	5	5	5

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 370 900 0100 Email: enquiries@metoffice.gov.uk

© Crown Copyright 2024. All Rights Reserved.

Figure 3: GOES 16-18 X-ray Flares. Showing Moderate activity during the 18 Nov and easing during the morning of the 19 Nov.



© Crown Copyright 2024. All Rights Reserved.

Solar Radiation Storms (High Energy Protons)

There is a slight chance of S1/Minor Solar Radiation storms over the period, chiefly due to any potential significant flaring from AR3889 as it approaches and rounds the western solar horizon. The series of inbound eastern limb regions are unlikely to present any appreciable risk to the daily probabilities of S1 in the near term.

Radiation Storms Probability (Exceedance)	Level ($cm^{-2}sr^{-1}s^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	5	5	5	5
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and/or 50 MeV ≥ 10pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 370 900 0100 Email: enquiries@metoffice.gov.uk

© Crown Copyright 2024. All Rights Reserved.

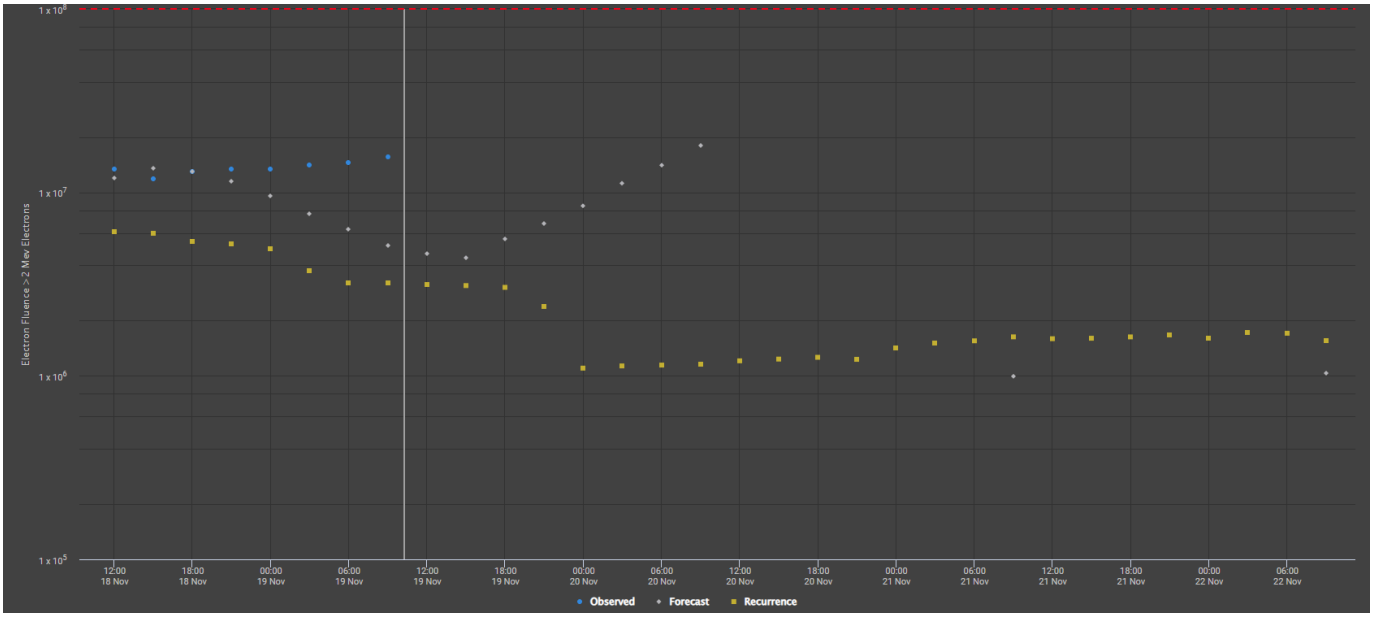
High Energy Electrons (≥ 2MeV)

Electron flux levels at GEO have been sitting in a fairly constant diurnal cycle, dropping to background levels during the overnight period (in UTC) and peaking at Moderate levels during the UTC afternoon. This pattern is expected to continue, although electrons perhaps becoming suppressed as the Van Allen belt compresses due to increased solar winds from the connection into CH93-/CH94- during the second half of the period. Following this, electrons may increase again as the Van Allen belt expands back to the location of GEO.

The initial values unlikely to be of sufficient magnitude to trouble the Active 24-hour integrated threshold - no persistent feature on the disc has resulted in Active fluence. MOSWOC REFM output viewed as providing reasonable guidance at present.

GEO Electron Environment	Level ($cm^{-2}sr^{-1}$ day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ 1×10^{8}	No	1	1	1	1
Very Active	≥ 2 MeV ≥ 1×10^{9}	No	1	1	1	1

Figure 4: MOSWOC REFM electron fluence.



Issued by Met Office Space Weather Advisor, Tel: +44 (0) 370 900 0100 Email: enquiries@metoffice.gov.uk

© Crown Copyright 2024. All Rights Reserved.